Step 3  We’ll save the last method for determining how much RAM is installed (looking inside your PC) for the next exercise in this lab. For the moment, let’s talk about how to determine the maximum amount of RAM a system can support.

The amount of RAM you can install on a modern system depends on the limitations of the motherboard hardware. The motherboard has a limitation as to the amount of RAM it will accept. Neither the CMOS setup utility nor the OS can help you determine how much RAM a motherboard can handle. You can usually find this information in the system’s motherboard manual, if you have it, or on the PC maker’s or motherboard manufacturer’s Web site.

Examine the documentation that came with your PC, or visit the manufacturer’s Web site, to determine how much RAM you can install on the system.

What is the maximum amount of RAM that your system can support? ________________

30 MINUTES

Lab Exercise 5.02: Identifying Types of RAM

Once you determine how much RAM is installed on Holly’s PC, and how much her motherboard can handle, you conclude that there’s room for more. “But,” you explain to Holly, “this doesn’t mean you can add that RAM stick you got, because not all RAM is the same.” Having looked at the specs for her system, you know it takes 240-pin DDR2 SDRAM sticks. Holly thinks the stick she got is the right size, but you know it’s 240-pin DDR3 RAM, so it won’t fit. This is why they pay you the big bucks.

RAM comes in several standardized form factors, each compatible with specific types of systems. Modern desktop systems use full-sized dual inline memory modules (DIMMs) of various pin configurations (168, 184, 240, and 288). Laptop computers use scaled-down sticks called small-outline DIMMs, or SO-DIMMs.

X  Cross-Reference

For details on the various types of RAM found in modern systems, refer to the “DDR SDRAM,” “DDR2,” “DDR3,” “DDR3L/DDR3U,” and “DDR4” sections in Chapter 5 of Mike Meyers’ CompTIA A+ Guide to Managing and Troubleshooting PCs.

The steps for identifying the different types of RAM are presented in this lab exercise.

Learning Objectives

In this lab, you’ll examine and compare different RAM packages.
At the end of this lab, you'll be able to

- Recognize and differentiate between different kinds of RAM packages

**Lab Materials and Setup**

The materials you need for this lab are

- Demonstration units of various RAM packages (optional)

✓ **Hint**

It is helpful to examine the RAM configurations in multiple PCs, if you have them available. Having a laptop with removable RAM is a plus.

**Getting Down to Business**

Let's do a quick review of the types of RAM packages you'll see in modern PCs. Then you'll check your PC or motherboard documentation to determine the type of RAM it uses.

All modern PCs use some form of DDR memory for their system RAM. As was discussed in the textbook, DDR stands for *double data rate*, which means that for every tick of the clock, two chunks of data are sent across the memory bus. This has the effect of giving you twice the performance without increasing the clock rate.

**Step 1** Another performance trick modern systems use to increase memory speed is dual- and triple-channel architectures. This enables the memory controller to access more than one stick of RAM at a time, thus increasing performance. In effect, the 64-bit bus acts like a 128-bit bus (for dual channel) or a 192-bit bus (for triple channel). To use these multichannel architectures, you must install memory in identical pairs or triplets. Check your motherboard manual. Does your system support dual- or triple-channel memory?

What colors represent the different channels?

**Step 2** There are many different types of RAM. It's important for you to be able to distinguish the difference between all of them by knowing what they physically look like and what their defining characteristics are. For each of the following descriptions, identify the type of RAM described by entering its name on the blank line preceding the definition.

a. ____________ This type of RAM comes in 168-pin packages. It uses two notches to help guide the installation of the module: one near the center, and the other near an end. It was the first type of DIMM technology commercially available for PCs and usually had a speed rating of PC100 or PC133.
b. The Rambus Corporation developed this type of RAM. It's usually found on a Pentium 4 motherboard. It is a proprietary stick of memory and uses 184 pins. It has two notches in it, both very near each other toward the middle of the stick.

If you are using a typical desktop system and it is relatively new (less than four years old), the motherboard will most likely support one of the following three types of RAM packages:

c. This type of RAM doubled the speed by transferring data on both the rising and falling edges of the clock cycle. It uses a 184-pin package and is completely incompatible with the memory developed by Rambus. This style has one notch in it.

d. Like its predecessor, it too transfers data on both the rising and falling edges of the clock cycle, but takes it one step further by doubling the clock speed twice. It uses a 240-pin package and has a single notch.

e. If doubling the clock speed twice wasn't enough, this type of RAM doubles it three times. It uses a 240-pin package, like some other types, but don't let that fool you: it is completely incompatible with all other types of RAM. Not only is it different electronically, but the notch is in a different place.

Step 3 In your PC or motherboard documentation, or on the manufacturer's Web site, locate the section listing the type of RAM your system uses.

a. What type of RAM does your system use?

b. What speed of RAM does your system need?

Step 4 Open your system case and make note of the following:

a. How many RAM slots does your motherboard have?

b. How many RAM slots are filled with RAM sticks?

c. Is your system set up to use single-channel, dual-channel, or tri-channel RAM? How could you find out?

30 MINUTES

Lab Exercise 5.03: Removing and Installing RAM

You've found a stick of RAM for Holly that works with her system, and now you have to install it. Although RAM installation is one of the simpler PC hardware upgrades, it's still important that you follow the correct steps and take all appropriate safety precautions.
Learning Objectives
In this lab, you’ll practice removing and installing RAM.
At the end of this lab, you’ll be able to
- Remove RAM safely and correctly
- Install RAM safely and correctly

Lab Materials and Setup
The materials you need for this lab are
- An antistatic mat or other static-safe material on which to place the RAM
- An antistatic wrist strap
- A notepad and pencil

✓ Hint
If you’re in a computer lab or you have access to multiple PCs, you should practice on a variety of systems.

Getting Down to Business
Removal and installation procedures vary depending on the type of RAM your system uses. DIMMs and RIMMs snap into the RAM slots vertically. The following steps describe the removal and installation procedures for DIMMs.

✗ Warning
Regardless of the type of RAM in your system, be certain to take measures to prevent ESD damage. Shut down and unplug the PC and place it on an antistatic mat. Strap on an antistatic bracelet and ground yourself. If necessary, remove any cables or components that block access to the system RAM before you begin.

PART 1: REMOVE THE EXISTING RAM

Step 1 Open the PC case. Use whatever methods the case requires: some use screws, some use latches. Once the case is open, look for the RAM sticks on the motherboard, as in Figure 5-4. Locate the retention clips on either end of the RAM modules.
Lab Materials and Setup
The materials you need for this lab are

- Access to a working computer with the utility CPU-Z installed
- A notepad and pencil to document the specifications

This lab is more informative if you have access to different types of systems with different types of RAM.

Getting Down to Business
In the following steps, you'll explore the different characteristics of RAM.

Step 1  Launch the CPU-Z application.

Step 2  Navigate to the Memory tab. The CPU-Z utility displays the current statistics of the RAM installed, as shown in Figure 5-5.

Using the data gathered by CPU-Z, record the following information:

Type ____________________
Size ____________________
CAS# Latency (CL) ________________

![CPU-Z showing RAM information](image)

**Figure 5-5** CPU-Z showing RAM information
Figure 5-6 CPU-Z showing SPD information

RAS# to CAS# Delay (tRCD) ______________
RAS# Precharge (tRP) ______________

Step 3 Click the SPD tab in CPU-Z.

Step 4 The SPD tab, shown in Figure 5-6, lists a number of technical bits of information about a particular stick of RAM. This information is contained on every RAM stick in a chip called the serial presence detect (SPD) chip.

Using the data gathered by CPU-Z, record the following information for each of the system's RAM modules:

<table>
<thead>
<tr>
<th>Slot #</th>
<th>Module 1</th>
<th>Module 2</th>
<th>Module 3</th>
<th>Module 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max Bandwidth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cross-Reference

To review how the SPD chip works with the system, refer to the "Serial Presence Detect (SPD)" section in Chapter 5 of Mike Meyers' CompTIA A+ Guide to Managing and Troubleshooting PCs.

Step 5  If possible, launch CPU-Z on various machines to compare the characteristics of different types of RAM. Save the utility for use in future lab exercises.

Try This: PC Wizard

On a Windows Vista, 7, or 8.1 computer with Internet access, point your browser to the following Web site: www.cpuid.com/softwares/pc-wizard.html. Follow the onscreen directions and download a copy of PC Wizard. Note that it doesn’t work, and won’t download or install, on Windows 10. You might see a compatibility warning in Windows 8.1, although it doesn’t stop the program from running.

Install and launch the PC Wizard application. Once PC Wizard is running, find and click the Mainboard icon in the Hardware area. This brings up a list of components in the right pane of the application window. Click the Physical Memory item and then browse through the information displayed in the lower portion of the window.

Using this information, can you determine the maximum size for individual RAM modules allowed on this system, and the maximum amount of total memory that it supports? Does this correspond to the information you found earlier in the PC or motherboard documentation? Note that because of variations in chipsets, BIOS, and motherboards, PC Wizard may or may not provide detailed information on the RAM. In some cases, the information may actually be erroneous.

Lab Analysis Test

1. Jarell wants to upgrade his memory on an older computer, and calls you for help. He knows that he’s using DDR RAM and that his system clock is 133 MHz, but he isn’t sure what type of DDR SDRAM sticks he should purchase. What DDR RAM would you recommend that he use?

2. Theresa's Windows Vista system has 1 GB of RAM. She adds another stick with 1 GB of RAM, but the RAM count still only shows 1 GB. What could be causing this?

3. John's system has 1 GB of PC4200 DDR2 SDRAM. He recently installed an additional 1 GB of DDR2 SDRAM that a coworker gave him. He tells you that his system now boots up correctly and shows the correct amount of RAM, but then it freezes after several minutes. He notes that if he removes the new RAM, the system runs fine. What could be a possible reason for this?
4. Kyle has a system that supports dual-channel architecture (there are two blue DIMM slots on the motherboard). The motherboard has space for three sticks of RAM, so Kyle installs three 2-GB RAM sticks. What will be the result?

5. Joe has recently purchased a pair of 1-GB DDR3 RAM sticks. He’s replacing an older pair of DDR2 RAM but can’t afford to replace the motherboard. Why won’t this work?

**Key Term Quiz**

Use the following terms to complete the following sentences. Not all terms will be used.

- 168-pin DIMM
- 184-pin DIMM
- 240-pin DIMM
- 288-pin DIMM
- CRIMM
- DDR RAM
- DDR2 RAM
- DDR3 RAM
- DIMM
- dual channel
- megabytes (MB)
- RIMM
- SDRAM
- SO-DIMM
- SPD

1. DDR2 and DDR3 RAM both come in a(n) _____________ package, but they are not pin-compatible, so they can’t be interchanged.

2. A RAM module used in a laptop is called a(n) ________________.

3. A component known as a(n) ________________ chip provides additional information about an SDRAM module.

4. A stick of ________________ looks a lot like a 168-pin DIMM, but it has 184 pins.

5. The technology that uses two sticks of RAM together to increase throughput is known as ________________ architecture.

6. When purchasing ________________, you must realize that it is not backward compatible with ________________ and new hardware must be considered.